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THESIS

STUDY OF GENDER DIFFERENCES IN PERFORMANCE AT THE U.S. NAVAL ACADEMY AND U.S. COAST GUARD ACADEMY

by

Pride L. Sanders

June 2005

Co-Advisors: Mark J. Eitelberg
Linda Mallory

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This thesis compares the academic and military performance of women with that of men at the U.S. Naval Academy (USNA) and U.S. Coast Guard Academy (USCGA). Measures of performance are grade-point average and military proficiency scores. The SAT scores for men and women at the two academies were also compared. The population included the Classes of 1997 through 2003, totaling 1,184 cadets from USCGA and 6,598 midshipmen from USNA. A number of hypotheses were tested quantitatively for all cadets and midshipmen from these classes as well as for those who majored in a technical discipline. The results indicate that women at the two academies generally perform as well or better than do their male counterparts. This was especially true on measures of military proficiency, where women tended to outperform men, particularly those who were enrolled in a technical major. Further research should seek to explain gender differences in performance, given the pressures on women at these institutions and differences in scores on the SAT. Continued study of gender differences is recommended, and examples of possible research are provided.

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Pride L. Sanders
Lieutenant, United States Coast Guard
B.S., South Carolina State University, 1998

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Author: Pride L. Sanders

Approved by: Dr. Mark J. Eitelberg
Co-Advisor

Dr. Linda Mallory
Co-Advisor

Dr. Douglas A. Brook
Dean, Graduate School of Business and Public Policy

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To my wife, Vonetta, and all of my family…..I did it…thanks for the prayers and understanding.

To the USNA & USCGA….thanks for the opportunity.

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I. INTRODUCTION

A. BACKGROUND

The United States Coast Guard Academy is committed to producing the nation's premier maritime officers by educating, training, and developing leaders. The men and women who enter the Coast Guard Academy come from diverse ethnic, religious, racial, and academic backgrounds. In March 2003, the U.S. Coast Guard was moved from the Department of Transportation (DOT) to the newly formed Department of Homeland Security (DHS). Being the lead agency, and the first line of defense in protecting U.S. ships, ports, and waterways at home and abroad, the Coast Guard must remain "SEMPER PARATUS-Always Ready" and able to answer the call. Homeland preparedness may then be said to start at the Coast Guard Academy, where the service trains its future leaders.

The U.S. Navy and U.S. Coast Guard, the nation's two seafaring services, share a rich history of traditions and experiences. One of the most noteworthy of the shared experiences was the admission of women to the U.S. Naval Academy and U.S. Coast Guard Academy in 1976, subsequently graduating their first coed classes in 1980. The Coast Guard Academy's current student population is almost 30 percent female; at the Naval Academy, women account for just fewer than 20 percent of students. Selection to either institution is highly competitive. Individuals must not only be smart and athletic, but also possess the ability to be developed into the leaders of the future fleets. Both institutions pride themselves on their maritime services and skills. The navigational rule of the road, considered by many the "Bible of the Sea," does not vary from one service to the other regarding prudent seamanship.

B. PURPOSE

The purpose of this research is to compare gender differences in academic and military performance at the two service academies, focusing on grade-point average, military proficiency scores, and standardized test results. Currently, both academies stress gender equity in and out of their classrooms. In male-dominated environments such as service academies, it is especially important to monitor the opportunities and achievements of women as their presence grows. In fact, since the late 1990's, the Coast

Guard Academy has made tremendous strides toward achieving a female population that constitutes one-third of the Corp of Cadets.

Using the Naval Academy as a benchmark, this study attempts to gauge similarities and the differences in the academic and military performance between men and women. By benchmarking the Coast Guard Academy with its most closely related service academy, Coast Guard Academy officials can identify areas that may possibly require greater attention in the future.

C. METHODOLOGY

The thesis includes: (1) a review of literature on gender equity in education; (2) a review of admission criteria at the two academies; and (3) a review of academic and military performance outcomes at the two institutions. Data for this project were obtained from the Institutional Research (IR) Departments of the Coast Guard Academy and Naval Academy. Data are taken from cadet/midshipmen records in the IR database from the Classes of 1997 through 2003. The cadet/midshipmen data are analyzed using descriptive and inferential statistics.

D. ORGANIZATION OF STUDY

This thesis is organized into five chapters. Chapter II reviews literature related to women and gender equity, historical and background information on women and their admission to the service academies, and academic success. Chapter III describes the research methodology. Chapter IV presents the results of analysis of data obtained on male and female cadets and midshipmen. Chapter V presents conclusions from the research and offers recommendations for future research.

II. LITERATURE REVIEW

A. INTRODUCTION

No research could be found that compares the U.S. Coast Guard Academy with the U.S. Naval Academy on the basis of gender differences in academic and military achievement. Studies exclusively on the subject of gender differences at these two academies tend to focus on the home institutions. Yet, it seems only natural that the policies, programs, and experiences of the two academies should be compared, since the schools are so closely tied in their seagoing mission, culture, and traditions.

This chapter is divided into three sections. The first section examines gender issues in higher education, including the military service academies. The second section looks at gender differences on standardized tests and military performance grades in a study at West Point. This is followed by a discussion of the minimum requirements for admission to the service academies.

B. GENDER ISSUES IN HIGHER EDUCATION

1. Gender Equity

Do gender differences still exist in higher education? It has been over 30 years since the enactment of Title IX, which was intended to equalize the participation of women and men in all federally funded institutions. In 1972, the basic premise of Title IX was as follows: “No person of the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subject to discrimination of, or be subject to discrimination under any education program or activity receiving Federal financial assistance” (Rhoads, 2004, p. 86). Although Title IX aims at ensuring fairness, it cannot address all of the questions about what constitutes fairness. Indeed, gender equity is a very subjective concept, except in its most extreme instances of violation.

Increased participation by women in math, science, and engineering has been an ongoing objective of educators and policy makers throughout the U.S. In the fall of 1998, President Clinton signed legislation that created a commission to study the status of women in science and engineering, and to evaluate the barriers that seem to prevent women from entering into these areas (Campbell and Clewell, 1999).

Much literature exists from the early 1980s that discusses gender inequities in certain educational fields, such as mathematics. All students should have an equal opportunity for success, regardless of gender. Adams (1998), for example, looked beyond measures such as choice of major or math SAT score, and attempted to understand why women seem to perform below men in mathematics. The author concluded that a lack of mathematics preparation early in the life of a child limits the ability to pursue certain majors in secondary education, or places the student behind due to the need to take preparatory courses and to catch up. These findings are similar to those of Boaler (2002) and Kelly (2002), who also examined the need to shift away from the idea that women are maladaptive or conceptually lacking, and focus more on the specific environmental circumstances that lead to differences between men and women.

According to Damarin (2000), mathematical ability is a marked category, which is defined as "any group of individuals whose bodies are assumed to bear the same marks of deviance: women, blacks, people of color, Jews, criminals, homosexuals, or persons of disability" (Damarin, 2000, p. 72). This research is based on the notion that a person's ability in certain areas, such as mathematics, is based largely on biological or genetic factors that can be linked to race, gender, ethnicity, or some other identifiable characteristic. Similarly, Campbell and Clewell (1999) conclude that, when one uses genetics as the basis for everything from unequal opportunities to unequal results, math is legitimized as a male domain.

Nurturing a young woman's passion for science or mathematics has proven to be more difficult than expected. Damarin (2000) discusses the role that schools, media, and family play in perpetuating the belief that women are naturally weaker in math than are men. In his research, he mentions two interesting examples: the "talking" Barbie doll that tells young girls "math is hard," and the celebrated "3 R's" (reading, 'riting, and 'rithmetic), where arithmetic is clearly separated from the two verbal subjects. Signals persist that, when a student fails to develop reading or writing skills, they are labeled as learning disabled; however, when a student fails to develop arithmetic skills, it is not explained as genetically human, but rather as genetically determined within humans (Damarin, 2000).

All students are expected to know how to read and write, but not all are expected to know how to do math. Many teachers have unknowingly stereotyped mathematics as a "marked category." More often than not, students who fail in mathematics are found to be less embarrassed than when they fail in other subjects. They may even view their supposed inability in math with a certain sense of pride (Damarin, 2000).

As many researchers observe, teachers play an important role in helping students feel positive when doing mathematics. The classroom setting is extremely important in this process. By holding high expectations for both genders in class, teachers become the model of gender equity. School environments play a major role in shaping the views women have about their abilities to succeed. Many schools are driven by expectations of what the community expects. Butler (2000) and Adams (1998) observed the school culture has a great impact on what is taught and learned inside and outside of the classroom. Thus, young men traditionally are driven toward technological fields, while young women are steered toward non-quantitative subjects. Adams (1998) states that all students should have an opportunity for success in mathematics, regardless of gender; and, as leaders in education, teachers are responsible for promoting gender equity as well as general equity.

Other research has looked at the cognitive factors that contribute to gender differences in learning mathematics. Jones and Smart (1995), for example, conclude that self-confidence is an important influence on an individual's belief in himself or herself. This confidence is affected by a number of variables, such as talent, learned helplessness, unfamiliar technology, as well as a teacher's approach in the classroom. Even when girls are successful in mathematics, they will often express a "fear of success" more than boys (Mittelberg & Lev-Ari, 1999).

Kelly (2002) writes that educational quality will likely not improve without educational equality, and that this understanding should begin in pre-service teacher preparation. By using both qualitative and quantitative methods for pre-service teachers, Kelly concludes that most teachers could not identify inequity, because they had never seen it in their lives. Her other findings are consistent with those of Boaler (2002), who adds that the approach by most researchers in the past failed to look at the teaching or

learning environments for young women, and this failure could be misleading in results. Similar to Jones and Smart (1995), Boaler (2002) finds that the common theme of why women are lacking in mathematics when compared with men is due to three factors: teachers, school culture, and parental influence. Boaler thus concludes that the environment, rather than institutionalized categories, such as gender or culture, may be a more fruitful area for research regarding equity.

At the college level, it is interesting to observe that young men tend to enroll in more math classes than do their female counterparts, and men are also more inclined to take advanced math classes. At the same time, young women represent about 56 percent of the undergraduate college population. Furthermore, about 300,000 more women than men attend graduate school (Poe, 2004).

2. History of Women at Service Academies

In 1976, women were admitted to the three service academies for the first time in United States history. In 1975, President Ford signed Public Law 94-106, requiring that the halls of West Point, the Naval Academy, and the Air Force Academy be opened to women. The United States Coast Guard Academy, which is also a federally funded service academy, was the first service academy to actually admit women in 1976 (Holm, 1992).

In the first class entering in 1976, women represented 6 percent at Annapolis, 8 percent at West Point, and 10 percent at the Air Force Academy. The first classes of women graduated in June 1980. Of the 327 women who entered, 66 percent, or 217, graduated. The attrition rate for academic reasons among men (1 in 5) during those years was twice as high as the rate for among women (1 in 10). Women in the graduating Class of 1980 thus broke a long-standing tradition of over a hundred-plus years of all-male enrollment at each institution. With virtually no role models, women in the Class of 1980 stood as pioneers, charting entirely new territory (Holm, 1992).

Over the course of the past 20-plus years, women have met many challenges, and have shown that they are capable of handling the physical and military courses at each service academy. Today, the career opportunities are almost boundless for every female graduate of the Naval Academy or Coast Guard Academy, with few exceptions. The

exceptions are that women may not be assigned to submarines, special warfare positions, or the majority of Marine Corp ground combat units (United States Naval Academy, 2003). Women graduating from the Coast Guard Academy are not excluded from any Coast Guard assignment. The only restriction for men or women is billet structure in certain operational units.

C. PERFORMANCE MEASURES IN HIGHER EDUCATION

1. SAT Scores [1]

The literature is rich in using the SAT score as a predictor of academic success in the freshman year, and to help understand academic readiness at higher education institutions. The Educational Testing Service (ETS) has administered the SAT since 1926. It is comprised of only math and verbal questions. The math section currently consists of arithmetic, algebra, and geometry, while the verbal section consists of vocabulary, verbal reasoning, and verbal comprehension (Lynn and Mau, 2001). As of March of 2005, the SAT also includes a writing section. The new SAT is similar to the SAT II, which is already in use.

For over 70 years, the most popular predictor of academic suitability during the first academic year has been the SAT. The SAT was designed to predict the performance of secondary school students in college, and in the nearly 80 years since ETS has been administering the test, SAT scores have been dedicated to performing that task. However, Leonard and Jiang (1999) found that the SAT score has flawed predictions when it comes to female performance relative to that of men. Women actually earn higher grades in college than do men with identical SAT scores.

Lynn and Mau (2001) surveyed a representative sample of American college graduates who obtained degrees between July 1, 1992, and June 30, 1994. The final sample (n=10,080) included college graduates at a total of 1,386 institutions from the United States, District of Columbia, and Puerto Rico. The authors looked primarily at the mean scores for the SAT Math, SAT Verbal, and ACT. The ACT is a college entrance examination that is similar to the SAT. The ACT covers four subject areas: English,

[1] The letters "SAT" were originally an abbreviation for Scholastic Aptitude Test, the oldest and most widely used college entrance examination in the U.S. The name of the exam was changed to Scholastic Assessment Test in 1993. This name was subsequently dropped. Currently, the test is known simply as the SAT I. The SAT II is a group of achievement tests for specific subjects.

Mathematics, Reading, and Science. The results of the study showed that men obtained significantly higher mean scores on all three tests (SAT Math, SAT Verbal, and ACT) and that the male advantage was greatest on the SAT-Math and least on the SAT-Verbal. The findings also indicate that women obtained a significantly higher mean than did men for grade point average (GPA).

Lynn and Mau (2001) believe that the higher grades obtained by women are a result of two factors. The first factor is that women tend to have a stronger work ethic than do their male counterparts, and it is likely to be expressed more on performance of course work, for which grades are normally based. The second factor is that women do better than men on essay writing and spelling, which are not tested in the SAT or ACT, but are likely to contribute to grades. The authors also conclude that men tend to have an advantage over women on assessments based on cognitive tests, while the opposite is true for assessments based on coursework, where women have the advantage (Lynn and Mau, 2001).

For over 30 years, researchers have been troubled by the fact that women tend to do better in college than the SAT predicts. Early on, women were labeled as "overachievers." In the early 1970s, the reason for women's higher performance was attributed to their course-taking patterns. Lately, women's success in school has been explained by gender differences in work ethic or motivation (Hyde and Kling, 2001). Although the under-prediction is only a small portion of the GPA, Leonard and Jiang (1999) attempt to demonstrate that the small under-prediction, in fact, negatively affects a large number of women in being selected for highly competitive colleges and universities. Additionally, the methods used to correct the under-prediction are inadequate and unstable, thus creating problems for public colleges and universities (Leonard and Jiang, 1999).

The SAT math score is also used to select candidates for special programs at the junior high school level. Talent search sites, for example, are used to offer summer courses to students, which in turn often accomplish the equivalent of a year of high school study in about 2 or 3 weeks. The result is that a student can complete high school math or science courses and begin college-level work while still in high school.

Rebhorn and Miles (1999) found that the gender gap on SAT Math scores is likewise apparent at the middle-school level. When approximately 160,000 middle-school students each year participate in a nation-wide talent search, the spaces are typically filled with fewer girls than boys, who are deemed to be more gifted because of their higher SAT Math scores. The researchers conclude that the opportunity to participate in special summer programs is a significant benefit to students. It increases enthusiasm for learning and life, enhances self-esteem, and promotes working with intellectual peers, to name just a few benefits of the programs.

Many reasons have been offered in the research literature to explain differences between the scores of boys and girls on measures of mathematical ability. These reasons include:

1. The SAT is biased against young women; differences in scores do not reflect actual differences in ability.
2. Boys have genetically superior mathematics ability and/or aptitude.
3. Boys' scores are more variable, so more high scorers occur among boys.
4. The timed nature of the test contributes to lower test scores for girls.
5. Girls take fewer mathematics courses, so are less prepared for the test.
6. Parents' expectations for their daughters are lower than for their sons.
7. Expectations of school/teacher/counselors/peers are different for girls.

All of the explanations above have their supporters and critics; however, more recent research tends to discount the idea that girls and boys have significant biological differences in mathematics ability (Rebhorn and Miles, 1999).

Rebhorn and Miles (1999) offer two proposals regarding genetic differences in SAT Math scores. The first proposal is to establish different cut-off scores for girls and boys to account for the current gap. In addition, the authors recommend that factors other than SAT Math scores be used to evaluate a student's ability to complete the course they would like to take. The solutions are not presented to necessarily correct the gender gap in SAT Math scores, but rather to accomplish the goals of the programs. The programs are used to identify students who are likely to benefit from and become successful in the special programs designed for academically talented youth.

Over the past 20 years the difference in the average scores of young men and women on the SAT Verbal and SAT Math have steadily increased. Research indicates that young women tend to achieve higher scores than do their male counterparts on the SAT Verbal, while young men continue to outperform their female counterparts on the SAT Math. Many have attributed this to a variety of factors, such as cognitive abilities, biases on the test, or differences in classroom experience (Young and Fisler, 2000).

As with most universities, the service academies rely heavily on SAT scores to predict an applicant's academic suitability. The weights assigned for the SAT Math score and the SAT Verbal score at each institution tend to differ. For the Naval Academy, the SAT Math score is given a total weight of 34 percent of the candidate multiple score (a score used by admissions officials to select best-qualified candidates), whereas the SAT Verbal score is given a weight of only 11 percent (Goss, Watson, Culler, & Zettler, 1999). Similarly, at the Coast Guard Academy, to calculate the finalist scores (those who will be assessed by the Cadet Candidate Evaluation Board or CCEB), the SAT Math score is weighted twice as heavily as the SAT Verbal score (United States Coast Guard Academy, 2004c).

2. Military Performance Grades at U.S. Military Academy

Bartone, Snook, and Tremble (2002) look at the cognitive and personality predictors of leader performance in West Point cadets. The authors used a composite military development (MD) grade for each cadet in the Class of 1998 (n=1,143). Grades for the MD are assigned on a 4-point scale.

The MD grade is employed in the study because it measures 12 basic leader dimensions that relate to a cadet's duty performance as a leader. These 12 dimensions are motivation, military bearing, teamwork, influencing others, consideration for others, professional ethics, planning and organizing, delegating, supervising, developing subordinates, decision making, and oral and written communication. The MD grade is only used in the junior and senior years because of the vast responsibilities placed on each cadet during that time.

Using a series of correlations followed by regression models, the authors conclude that both cognitive and personality variables, assessed prior to freshman year, can predict

leadership performance 3 to 4 years later in West Point cadets. Furthermore, when demographic variables are entered into the first-order correlations, gender is found to be associated with leader performance. Probably the most significant finding is that female cadets performed better than men on the MD composite score (Bartone, Snook, and Tremble, 2002).

The authors suggest that the gender differences at entry could at least partially explain why women perform better as leaders in these predominately male institutions. However, the authors did not expect to find that women continue to out-perform their male counterparts in leadership dimensions as upper-class cadets (Bartone, Snook, Tremble, 2002).

D. ADMISSION TO SERVICE ACADEMIES

1. U. S. Naval Academy

Admission to the U.S Naval Academy is both a highly competitive and extremely selective process. The admissions board is responsible for reviewing academic records, medical condition, physical fitness, and leadership motivation to select the best-qualified candidates for the Academy (United States Naval Academy, 2003). For the Class of 2006, of the 12,331 applicants and nominees, only 1,476 were offered admission, and of those selected, 16 percent (192) were women (United States Naval Academy, 2003). Women typically comprise 15-17 percent of the incoming classes (United States Naval Academy, 2003).

The criteria for admission to the Naval Academy are the same for women and men, with the exception of some physical standards (United States Naval Academy, 2003). Applicants must meet the following requirements:

Be a United States citizen (except for limited number of international students);

Show good moral character;

Be at least 17 and not past the 23rd birthday on 1 July of the entry year;

Be unmarried, not pregnant;

Have no dependents;

Be found scholastically qualified by the admissions board;

Be medically qualified;

Pass the Physical Aptitude Exam from any service academy; and

Receive an official nomination (United States Naval Academy, 2003).

2. U.S. Coast Guard Academy

Very similar to the Naval Academy, the Coast Guard Academy is also highly selective and competitive for admission. The Admissions Division is responsible for identifying candidates who would reflect the quality, diversity, and objectives of the Coast Guard Academy. Successful students graduate with a Bachelor of Science (BS) degree and also serve as officers in the United States Coast Guard (United States Coast Guard Academy, 2003b). Each year, thousands of applicants apply to the Academy, but only a percentage of these are selected. For the Class of 2006, of the 4,911 applicants and nominees, only 291 were sworn in; of those selected, 27 percent (79) were women (United States Coast Guard Academy, 2002).

The admissions standards for men and women at the Coast Guard Academy are the same, with the exception of standards for physical fitness. Applicants must meet a few preliminary steps and requirements:

Be a United States citizen;

Be unmarried with no dependents or financial debt;

Be 17-22 years of age (not 23 by 1 July of year of entry);

Be a high school graduate;

Demonstrate high academic performance; and

Successfully pass a medical and physical fitness exam (United States Coast Guard Academy, 2004d).

Selecting the best-qualified candidates is of utmost importance to both the Naval Academy and Coast Guard Academy. All of the service academies look primarily at the same pre-college variables, such as high school rank, high school GPA, extra-curricular activities, SAT scores, and a host of other aspects of an applicant's background.

Laws prescribe many of the entrance criteria and application procedures, and the similarities are common in the admission processes. However, there is one major difference in the admission standards between the two academies: a formal nomination is

needed for selection to the Naval Academy. This formal nomination must come from the President, Congress, Superintendent, or Secretary of the Navy (Collins, 1987).

E. CHAPTER SUMMARY

This chapter highlights several findings from the research literature to describe how women compare with men in academic achievement and selection for enrollment by colleges. A concern is that, with the two service academies relying heavily on technical majors, are women at an unfair disadvantage? Researchers have used a variety of methods and data sets, to draw a number of conclusions about the apparent differences in achievement between genders. The reasons for these differences are explained in various ways, from the innate, genetic influences, to continuing practices in educational programs, to a number of other environmental factors that affect boys and girls differently. One issue surfaces repeatedly in the literature: namely, that young women are relatively under-prepared in mathematics, at least when compared with their male counterparts. Nevertheless, as shown in the study by Bartone, Snook, and Tremble (2002), women have proven themselves able to adapt to the rigors of a male-dominated environment. The next chapter describes the approach used to compare the two service academies on the basis of gender differences in academic and military achievement.

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III. RESEARCH METHODOLOGY

A. INTRODUCTION

The major source of motivation in a program evaluation comes from a hypothesis, or question that is asked or stated (Royce, Thyer, Padgett, Logan, 2001). A program evaluation is primarily used to ensure that what one is trying to achieve (objectives or outcomes) through procedures, rules, etc., is being accomplished in the best way possible. Royce and his associates (2001) describe a program evaluation as a practical endeavor, not an academic exercise, and not an attempt to build theory or necessarily develop social science knowledge. This is important because the present study does not attempt to build theory, but to primarily serve as a tool for both academies to measure gender differences and draw conclusions.

This chapter describes the data and variables that were used to investigate the academic and military performance of men and women, as outlined in Chapter I. This is followed by a discussion of the theory for using descriptive and inferential statistics as the statistical procedure. Finally, the chapter introduces the statistical models employed the analysis.

The study focuses on cadets (at the Coast Guard Academy) and midshipmen (at the Naval Academy) in the Classes of 1997 through 2003. The total number of cases for the Coast Guard Academy is 1,184. Data on the Coast Guard Academy cadets were missing SAT scores for the Classes of 1997 through 1999, so these cases are excluded when analyzing SAT scores. Additionally, two cases were missing cumulative grade-point average (CGPA) and cumulative military precedence score (CMPL).

The total number of cases for the Naval Academy is 6,598. The data on Naval Academy midshipmen were complete and valid for the Classes of 1997 through 2003. Because the Coast Guard Academy data were missing SAT scores for the Classes of 1997 through 1999, the scores for the same year-groups at the Naval Academy are excluded from the analysis of this dependent variable.

B. DATA DESCRIPTION AND VARIABLES

1. Coast Guard Academy Data Description and Variables

The data used for this study were obtained from the Coast Guard Academy's data warehouse in New London, Connecticut. The gender of each cadet was recorded upon acceptance into the Coast Guard Academy. The cadet's major was recorded from the information obtained by the departments responsible for academic development. The independent variables, gender and major, are summarized in Table 1.

Table 1. Coast Guard Academy Independent Variables

VARIABLE	DATA TYPE	RANGE
Gender Status	Nominal	Female/Male
Tech Major	Nominal	Yes/No

With the exception of SAT scores, which are reported to the Coast Guard Academy by the College Board, the Coast Guard Academy obtained the scores on all the other dependent variables from the departments responsible for the academic and military development of cadets. The four dependent variables in the analysis are summarized in Table 2 below.

Table 2. Coast Guard Academy Dependent Variables

VARIABLE	DATA TYPE	RANGE
SAT Math	Ratio	480 - 800
SAT Verbal	Ratio	400 - 800
CGPA	Ratio	2.03 - 4.0
CMPL	Ratio	428.05 - 875.04

2. Coast Guard Academy Independent Variables

Gender Status simply identifies whether a person is female or male. The original character values were Male and Female. Female was recoded to a numeric value of 1, and Male was recoded to a numeric value of 0. All of the individual cases (n=1,184) had a valid entry for this variable.

Tech Major is defined as any person who had an engineering or science major at the Coast Guard Academy. The original character value represents nine different major choices at the Coast Guard Academy, as shown in Table 3. These three separate groups were recoded into two groups. Engineering and Math/Science Majors were recoded into a numerical value of 1, and became the technical major group. Social sciences were recoded into a numerical value of 0 for the non-technical majors. All of the individual cases (n=1,184) had a valid entry for this variable.

Table 3. Coast Guard Academy Academic Major Codes

ENGINEERING
Mechanical Engineering
Naval Architecture and Marine Engineering
Civil Engineering
Electrical Engineering
MATH/SCIENCE
Marine and Environmental Sciences
Math and Computer Science
Operations Research
SOCIAL SCIENCE
Government
Management

3. Coast Guard Academy Dependent Variables

SAT Math is a numerical value that ranges from 480 to 800. All of the individual cases did not have a valid entry for SAT Math. SAT math scores for the classes of 1997 through 1999 (n=673) were not available.

SAT Verbal is a numerical value that ranges from 400 to 800. All of the individual cases did not have a valid entry for SAT Verbal. SAT verbal scores for the classes of 1997 through 1999 (n=673) were not available.

CGPA is the cumulative grade point average for each cadet. It is based on all the course work completed since the first course at the Academy. CGPA was taken from the Grad_CGPA variable in the data warehouse for each cadet. It is a numerical value

ranging from 2.03 to 4.0. All of the cadets had valid entries with the exception of two cases (n=1,182).

CMPL is the cumulative military precedence list. It is used to evaluate the performance of cadets in the military programs at the Academy. CMPL was taken from the Grad_CMPL variable in the data warehouse for each cadet. It is a numerical value ranging from 428.05 - 875.04, with 1,000 points being the maximum amount possible per term. All of the cadets had valid entries with the exception of two cases (n=1,182).

4. Naval Academy Data Description and Variables

The data used for this study were obtained from the Naval Academy's Office of Institutional Research (IR). A midshipmen's gender was recorded upon acceptance into the Naval Academy. A midshipmen's academic major was recorded from the information obtained by the department responsible for academic development. The independent variables, gender and major, are summarized in Table 4 below.

Table 4. Naval Academy Independent Variables

VARIABLE	DATA TYPE	RANGE
Gender Status	Nominal	Female/Male
Tech Major	Nominal	Yes/No

With the exception of SAT scores, which are reported to the Naval Academy by the College Board, IR obtained the scores on all the other dependent variables from the departments responsible for the academic and military development of midshipmen. The dependent variables are summarized in Table 5 below.

Table 5. Naval Academy Dependent Variables

VARIABLE	DATA TYPE	RANGE
SAT Math	Interval	420- 805
SAT Verbal	Interval	360 - 805
CAQPR	Ratio	2.00 - 4.0
CMQPR	Ratio	2.13 – 3.91

5. Naval Academy Independent Variables

Gender Status identifies the gender as female or male. The original character values are shown as M (male) and F (female). F was recoded to a numeric value of 1, and M was recoded to a numeric value of 0. All of the individual cases (n=6,598) had a valid entry for this variable.

Tech Major is defined as any person who had an engineering or science major at the Naval Academy. The original character values represent 20 (the "honors" majors do not count as discrete majors at USNA) different choices of academic major at the Naval Academy, as shown in Table 6 below. The three groups shown in Table 6 were recoded into two groups. Engineering and math/science majors were recoded into a numerical value of 1, and became the technical major group. The social science and humanities group was recoded into a numerical value of 0 for the non-technical majors. All of the individual cases (n=6,598) had a valid entry for this variable.

Table 6. Naval Academy Academic Major Codes

ENGINEERING
EAS (Aerospace Engineering), EASA (Aerospace Engineering Astronautics), EEE (Electrical Engineering)
EGE (General Engineering), EME (Mechanical Engineering), ENA (Naval Architecture)
EOE (Ocean Engineering), ESE (Systems Engineering), ESP (Marine Engineering)
MATH/SCIENCE
SCH (Chemistry), SCS (Computer Science), SGS (General Science)
SMA (Mathematics), SMAH(Mathematics honors), SOC (Oceanography)
SOCH (Oceanography honors) , SPH (Physics), SQE (Quantitative Economics)
SOCIAL SCIENCE/HUMANITIES
FEC (Economics), FECH (Economics honors), FPS (Political Science), FPSH (Political Science honors)
HEG (English), HEGH (English honors), HHS (History), HHSH (History honors)

6. Naval Academy Dependent Variables

SAT Math is a numerical value that ranges from 420 to 805. It is noted that a score of 805, which is above the maximum value of 800, is due to re-centering[2]. All of the individual cases had a valid entry for SAT Math. As previously discussed, SAT scores for the Classes of 1997 through 1999 are not used in the data analysis (n=3,835).

SAT Verbal is a numerical value that ranges from 360 to 805 in the Naval Academy data files. As noted above, the scores were raised as a result of re-centering. All of the individual cases did have a valid entry for SAT Verbal. As previously discussed, SAT scores for the Classes of 1997 through 1999 are not used in the data analysis (n=3,835).

CAQPR is the cumulative grade-point-average on a 4.0 scale of a midshipman in all of the academic courses. CAQPR was taken from the variable CAQPR and is a numerical value ranging from 2.00 to 4.0. All of the cases had valid entries (n=6,598).

CMQPR is the cumulative grade-point-average on a 4.0 scale of a midshipman in all military areas, including conduct, honor, leadership, military performance, and physical readiness. CMQPR was taken from the variable CMQPR and is a numerical value ranging from 2.13 – 3.91. All of the cases had valid entries (n=6,598).

C. STATISTICAL THEORY

1. Descriptive and Inferential Statistics

Descriptive statistics help to explain samples in terms of variables or combinations of variables. Inferential statistics test hypotheses about differences in populations on the basis of measurement made on a sample of subjects. If reliable differences are found, descriptive statistics are used to provide estimations of central tendency, and the like, in the population (Tabachnick and Fidell, 2001).

Measures of central tendency calculate the “middle-ness” of the data. This is accomplished by looking at the mean, mode, and median. The mean is the sum of all the values divided by the number of values in the data. The median is the middle value, if all the values are in rank-order. If there is an even number of values, the median is the mean

[2] “Re-centering” is a process used by the College Board to reset the midpoint of the score range at 500, based on scores of a more recent reference population. The process places verbal and math scores on a comparable scale and reestablishes 500 as the “average.”

of the middle two values. The mode is the most frequently occurring value. Knowing the mean, mode, and median helps to evaluate the distribution of the data. If the data were perfectly distributed, the values for all three would be the same, producing a perfect bell curve (Norusis, 2002). Descriptive statistics for all Coast Guard Academy variables are shown in Tables 7 through 10; Naval Academy variables are shown in Tables 11 through 14.

Table 7. Coast Guard Academy Gender Status Frequencies

	GENDER STATUS	
	Frequency	Percent
Men	864	73.0
Women	320	27.0
Total	1,184	100.0

Table 8. Coast Guard Academy Technical Major Frequencies

	TECHNICAL MAJOR	
	Frequency	Percent
No	466	39.4
Yes	718	60.6
Total	1,184	100.0

Table 9. Descriptive Statistics for Women at the Coast Guard Academy

	SAT_Math	SAT_Verbal	CGPA	CMPL
Mean	632.44	627.88	2.86	688.60
Standard Error	4.29	4.62	0.02	4.21
Median	630	620	2.81	688.98
Mode	630	600	2.71	#N/A
Standard Deviation	59.67	64.20	0.44	75.20
Sample Variance	3560.18	4122.03	0.19	5654.75
Kurtosis	-0.05	-0.25	-0.42	-0.25
Skewness	-0.02	0.13	0.50	-0.12
Range	310	330	1.92	397.44
Minimum	480	470	2.03	476.79
Maximum	790	800	3.95	874.24
N	193	193	319	319

Table 10. Descriptive Statistics for Men at the Coast Guard Academy

	SAT_Math	SAT_Verbal	CGPA	CMPL
Mean	647.02	610.67	2.90	652.06
Standard Error	2.58	2.98	0.02	2.97
Median	650	610	2.84	649.735
Mode	630	600	2.66	553.449
Standard Deviation	56.47	65.22	0.44	87.39
Sample Variance	3188.81	4253.83	0.20	7636.87
Kurtosis	0.27	0.20	-0.76	-0.59
Skewness	-0.06	0.00	0.32	0.06
Range	310	380	1.97	446.992
Minimum	490	400	2.03	428.05
Maximum	800	780	4	875.042
N	480	480	863	863

Table 11. Naval Academy Gender Status Frequencies

	GENDER STATUS	
	Frequency	Percent
Men	5,640	85.5
Women	958	14.5
Total	6,598	100.0

Table 12. Naval Academy Technical Major Frequencies

	TECHNICAL MAJOR	
	Frequency	Percent
No	2,643	40.1
Yes	3,955	59.9
Total	6,598	100.0

Table 13. Descriptive Statistics for Women at the Naval Academy

	SAT_Math	SAT_Verbal	CAQPR	CMQPR
Mean	649.84	641.02	2.96	3.15
Standard Error	2.53	2.68	0.01	0.01
Median	650.00	637.50	2.91	3.16
Mode	620.00	650.00	2.53	3.09
Standard Deviation	60.34	64.04	0.44	0.31
Sample Variance	3640.48	4101.42	0.19	0.10
Kurtosis	0.14	-0.03	-0.70	-0.26
Skewness	0.00	0.21	0.25	-0.22
Range	350.00	385.00	1.94	1.76
Minimum	455.00	420.00	2.06	2.13
Maximum	805.00	805.00	4.00	3.89
N	570	570	958	958

Table 14. Descriptive Statistics for Men at the Naval Academy

	SAT_Math	SAT_Verbal	CAQPR	CMQPR
Mean	665.41	633.08	2.95	3.14
Standard Error	1.09	1.15	0.01	0.00
Median	665.00	630.00	2.91	3.15
Mode	700.00	600.00	3.06	3.38
Standard Deviation	62.43	65.83	0.48	0.32
Sample Variance	3897.87	4333.30	0.23	0.10
Kurtosis	0.18	0.01	-0.85	-0.55
Skewness	-0.11	0.01	0.22	-0.21
Range	385.00	445.00	2.00	1.77
Minimum	420.00	360.00	2.00	2.14
Maximum	805.00	805.00	4.00	3.91
N	3265	3265	5640	5640

2. Normality

As Tabachnick and Fidell (2001, p.73) write, "Screening continuous variables for normality is an important early step in almost every multivariate analysis." A "normal curve" bell shape can be accomplished by drawing a curve around the top points on all the bars. Having a perfect bell shape is virtually impossible. However, two values in the descriptive statistics table can help to define the shape and distribution of a curve.

Assessing the normality of variables can be accomplished by either statistical or graphical methods (Tabachnick and Fidell, 2001). The two components from the descriptive statistics table that help to define the shape and distribution of a curve are skewness and kurtosis. Skewness is the symmetry of the distribution. A skewed variable is a variable whose mean is not in the center of the distribution. For positive skewness, the cases pile up to the left, and the right tail is long; for negative skewness, the cases pile up to the right and the left tail is long. Further: "Kurtosis has to do with the peakedness of a distribution; a distribution is either too peaked (with short, thick tails) or too flat (with long, thin tails). A distribution is normal when the value of the skewness and kurtosis is zero" (Tabachnick and Fidell, 2001, p. 73).

D. HYPOTHESIS TESTING

1. T-Statistic

Statistics are used to make rational decisions under conditions of uncertainty. Inferences are made about populations based on data from samples that contain incomplete information (Tabachnick and Fidell, 2001).

The *t*-statistic is most widely used to determine if there are differences between two means. The *t*-test design is based on two aspects. The first is the level of measurement of the dependent variable and the other is the type of independent variable.

Additionally, some assumptions must be met and established before using the *t*-test. These assumptions are as follows:

a. The dependent variable will be at least interval level;

b. The independent variable must be nominal or ordinal and must classify subjects in to separate categories or groups;

c. Variances must be essentially similar across both levels of the dependent variable (homogeneity of variance); and

d. Dependent variable scores should be essentially normally distributed (Anderson, Sweeney and Williams, 2001).

2. Data Analysis for Coast Guard Academy

The data are analyzed using MS-Excel and SPSS software. Descriptive statistics were computed to characterize the data, and hypothesis testing was accomplished by utilizing the *t*-test.

First, in terms of CGPA, CMPL, SAT Math, and SAT Verbal, it is expected that the mean of women would be statistically the same as that of men. Therefore, the null $(\mathbf{H}_O)$ and alternative $(\mathbf{H}_A)$ hypotheses are as follows:

$\mathbf{H}_O$ **:** μ Female Cadet CGPA = μ Male Cadet CGPA

$\mathbf{H}_A$ **:** μ Female Cadet CGPA ≠ μ Male Cadet CGPA

and

$\mathbf{H}_O$ **:** μ Female Cadet CMPL = μ Male Cadet CMPL

$\mathbf{H}_A$ **:** μ Female Cadet CMPL ≠ μ Male Cadet CMPL

and

$\mathbf{H}_O$ **:** μ Female Cadet SAT Math = μ Male Cadet SAT Math

$\mathbf{H}_A$ **:** μ Female Cadet SAT Math ≠ μ Male Cadet SAT Math

and

$\mathbf{H}_O$ **:** μ Female Cadet SAT Verbal = μ Male Cadet SAT Verbal

$\mathbf{H}_A$ **:** μ Female Cadet SAT Verbal ≠ μ Male Cadet SAT Verbal

The *t*-test is the method of choice when testing the means, and verifies if the differences are significant to the .05 level. The independent and dependent variables satisfy the assumptions previously noted to use the t-test. The results of the *t*-tests are presented in Chapter IV.

Similar hypothesis testing is used for gender and technical major. First, in terms of CGPA, CMPL, SAT Math, and SAT Verbal, it is expected that the mean of women by technical major would be statistically the same as that of men. Therefore, the null **(** $\mathbf{H}_O$ **)** and alternative **(** $\mathbf{H}_A$ **)** hypotheses are as follows:

$\mathbf{H}_O$ **:** μ Female Cadet CGPA by technical major = μ Male Cadet CGPA by technical major

$\mathbf{H}_A$ **:** μ Female Cadet CGPA by technical major ≠ μ Male Cadet CGPA by technical major

and

$\mathbf{H}_O$ **:** μ Female Cadet CMPL by technical major = μ Male Cadet CMPL by technical major

$\mathbf{H}_A$ **:** μ Female Cadet CMPL by technical major ≠ μ Male Cadet CMPL by technical major

and

$\mathbf{H}_O$ **:** μ Female Cadet SAT Math by technical major = μ Male Cadet SAT Math by technical major

$\mathbf{H}_A$ **:** μ Female Cadet SAT Math by technical major ≠ μ Male Cadet SAT Math by technical major

and

$\mathbf{H}_O$ **:** μ Female Cadet SAT Verbal by technical major = μ Male Cadet SAT Verbal by technical major

$\mathbf{H}_A$ **:** μ Female Cadet SAT Verbal by technical major ≠ μ Male Cadet SAT Verbal by technical major

The *t*-test is the method of choice when testing the means and it verifies if the differences are significant to the .05 level. The independent and dependent variables satisfy the assumptions previously noted to use the t-test. The results of the *t*-tests are presented in chapter IV.

3. Data Analysis for Naval Academy

The data are analyzed using MS-Excel and SPSS software. Descriptive statistics were computed to characterize the data, and hypothesis testing was accomplished by utilizing the *t*-test.

First, in terms of CAQPR, CMQPR, SAT Math, and SAT Verbal, it is expected that the means of women would be statistically the same as that of men. Therefore, the null **(** $\mathbf{H}_O$ **)** and alternative **(** $\mathbf{H}_A$ **)** hypotheses are as follows:

$\mathbf{H}_O$ **:** μ Female Midshipman CAQPR = μ Male Midshipman CAQPR

$\mathbf{H}_A$ **:** μ Female Midshipman CAQPR ≠ μ Male Midshipman CAQPR

and

$\mathbf{H}_O$ **:** μ Female Midshipman CMQPR = μ Male Midshipman CMQPR

$\mathbf{H}_A$ **:** μ Female Midshipman CMQPR ≠ μ Male Midshipman CMQPR

and

$\mathbf{H}_O$ **:** μ Female Midshipman SAT Math = μ Male Midshipman SAT Math

$\mathbf{H}_A$ **:** μ Female Midshipman SAT Math ≠ μ Male Midshipman SAT Math

and

$\mathbf{H}_O$ **:** μ Female Midshipman SAT Verbal = μ Male Midshipman SAT Verbal

$\mathbf{H}_A$ **:** μ Female Midshipman SAT Verbal ≠ μ Male Midshipman SAT Verbal

The *t*-test is the method of choice when testing the means and it verifies if the differences are significant to the .05 level. The independent and dependent variables satisfy the assumptions previously noted to use the t-test. The results of the *t*-tests are presented in Chapter IV.

Similar hypothesis testing is used for gender and technical major. First, in terms of CAQPR, CMQPR, SAT Math, and SAT Verbal, it is expected that the mean of women by technical major would be statistically the same as that of men. Therefore, the null **(** $\mathbf{H}_O$ **)** and alternative **(** $\mathbf{H}_A$ **)** hypotheses are as follows:

$\mathbf{H}_O$ **:** μ Female Midshipman CAQPR in technical majors = μ Male Midshipman CAQPR in technical majors

$\mathbf{H}_A$ **:** μ Female Midshipman CAQPR in technical majors ≠ μ Male Midshipman CAQPR in technical majors

and

$\mathbf{H}_O$ **:** μ Female Midshipman CMQPR in technical majors = μ Male Midshipman CMQPR in technical majors

$\mathbf{H}_A$ **:** μ Female Midshipman CMQPR in technical majors ≠ μ Male Midshipman CMQPR in technical majors

and

$\mathbf{H}_O$ **:** μ Female Midshipman SAT Math in technical majors = μ Male Midshipman SAT Math in technical majors

$\mathbf{H}_A$ **:** μ Female Midshipman SAT Math in technical majors ≠ μ Male Midshipman SAT Math in technical majors

and

$\mathbf{H}_O$ **:** μ Female Midshipman SAT Verbal in technical majors = μ Male Midshipman SAT Verbal in technical majors

$\mathbf{H}_A$ **:** μ Female Midshipman SAT Verbal in technical majors ≠ μ Male Midshipman SAT Verbal in technical majors

The *t*-test is the method of choice when testing the means and it verifies if the differences are significant to the .05 level. The independent and dependent variables satisfy the assumptions previously noted to use the t-test. The results of the *t*-tests are presented in Chapter IV.

4. Cross Tabulations by Gender

To show the relationship between women at the Coast Guard Academy and Naval Academy, cross-tabulations by gender were conducted. As McBurney (2001, p. 214) writes, "Correlation research seeks causes of behaviors by looking for correlations among variables." However, in non-experimental research, it is difficult to assess causality on an Independent Variable (IV) (Tabachnik and Findell, 2001). Correlational research is often a good precursor to answering other questions by empirical methods.

Correlations measure the strength of a relationship between two variables, where the results are either positive or negative. That is, as one goes up, the other goes up (positive); or as one goes down, the other goes down (negative) (Tabachnik and Findell, 2001). The Pearson correlation is used most commonly to measure the relationship between variables. It is expressed as a number that can take on any value between +1.0 and -1.0 (McBurney, 2001).

The data for the Coast Guard Academy and Naval Academy were combined into one complete data set. The results of the correlations for women at both institutions are presented in Chapter IV.

E. CHAPTER SUMMARY

This chapter describes the approach used to compile the data set and variables for comparing the academic performance of men with that of women at the Coast Guard Academy and Naval Academy. In addition, a brief explanation is presented for using descriptive and inferential statistics in the analysis. Finally, the chapter introduces the statistical model used for the analysis. Chapter IV presents the findings.

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IV. DATA ANALYSIS

A. INTRODUCTION

The first section of the chapter looks at data from the Coast Guard Academy and Naval Academy samples using descriptive statistics. The second section evaluates the study's hypotheses, using academic and military performance by gender and, then, academic and military performance for technical majors by gender. Additionally, the SAT scores are analyzed and compared at each institution. In the third section, cross-tabulations are employed to measure the relationship between women at both service academies with respect to Grad GPA, SAT Math, and SAT Verbal.

B. U.S. COAST GUARD ACADEMY

1. Comparison of Academic and Military Performance by Gender

This sample includes all of the men and women in the graduating classes of 1997 through 2003. The sample consists of 1,184 cadets. Of the sample, 864 cadets (73 percent) are male and 320 cadets (27 percent) are female.

Table 15 presents the academic and military means by gender at the Coast Guard Academy. The data show that men have a higher average CGPA (by .04). Women, however, have a higher average CMPL (by over 36 points).

Table 15. Academic and Military Means by Gender, Coast Guard Academy

	Men	Women	Average
GRAD_CGPA	2.90	2.86	2.89
GRAD_CMPL	652.06	688.60	661.92

Hypothesis testing was conducted comparing the sample means of men and women for CGPA and CMPL. Testing for CGPA on these presumptions resulted in acceptance of the null hypothesis at the .05 level of significance. No significant difference is found between the means of the CGPA of men and women at the Coast Guard Academy. The results are shown in Table 16.

Table 16. *t-test* for CGPA by Gender, Coast Guard Academy

t-Test: Two-Sample Assuming Equal Variances		
	Women	Men
Mean	2.86	2.90
Variance	0.193	0.196
Observations	319	863
Pooled Variance	0.195	
Hypothesized Mean Difference	0	
df	1180	
t Stat	-1.472	
P(T<=t) one-tail	0.071	
t Critical one-tail	1.646	
P(T<=t) two-tail	**0.141**	
t Critical two-tail	1.962	

Testing for the CMPL on these presumptions resulted in rejection of the null hypothesis at the .05 level of significance. A significant difference is found between the means of CMPL of men and women at the Coast Guard Academy. The results are shown in Table 17.

Table 17. *t-test* for CMPL by Gender, Coast Guard Academy

t-Test: Two-Sample Assuming Equal Variances		
	Women	Men
Mean	688.60	652.06
Variance	5654.75	7636.87
Observations	319	863
Pooled Variance	7102.71	
Hypothesized Mean Difference	0	
df	1180	
t Stat	6.618	
P(T<=t) one-tail	0.000	
t Critical one-tail	1.646	
P(T<=t) two-tail	**0.000**	
t Critical two-tail	1.962	

Table 18 presents the SAT means by gender at the Coast Guard Academy. The data show that men have a higher average SAT Math score (by almost 15 points). Women, however, have a higher average SAT Verbal score (by over 17 points).

Table 18. SAT Means by Gender, Coast Guard Academy

	Men	Women	Average
MATH_SAT	647.02	632.44	642.84
VERBAL_SAT	610.67	627.88	615.60

Hypothesis testing was conducted comparing the sample means of men and women for SAT Math and SAT Verbal. Testing for the SAT Math on these presumptions resulted in rejection of the null hypothesis at the .05 level of significance. A significant difference is found between the means of the SAT Math scores of men and women at the Coast Guard Academy. The results are shown in Table 19.

Table 19. *t*-test for SAT Math by Gender, Coast Guard Academy

t-Test: Two-Sample Assuming Equal Variances		
	Men	Women
Mean	647.02	632.44
Variance	3188.81	3560.18
Observations	480	193
Pooled Variance	3295.07	
Hypothesized Mean Difference	0	
df	671	
t Stat	2.981	
P(T<=t) one-tail	0.001	
t Critical one-tail	1.647	
P(T<=t) two-tail	**0.003**	
t Critical two-tail	1.964	

Testing for the SAT Verbal on these presumptions resulted in rejection of the null hypothesis at the .05 level of significance. A significant difference is found between the means of the SAT Verbal scores of men and women at the Coast Guard Academy. The results are shown in Table 20.

Table 20. *t*-test for SAT Verbal by Gender, Coast Guard Academy

t-Test: Two-Sample Assuming Equal Variances		
	Women	Men
Mean	627.88	610.67
Variance	4122.03	4253.83
Observations	193	480
Pooled Variance	4216.12	
Hypothesized Mean Difference	0	
df	671	
t Stat	3.109	
P(T<=t) one-tail	0.001	
t Critical one-tail	1.647	
P(T<=t) two-tail	**0.002**	
t Critical two-tail	1.964	

2. Comparison of Academic and Military Performance by Gender (Technical Majors)

Almost 61 percent (718 cadets) are in technical majors, and 39 percent (466 cadets) are in non-technical majors. Table 21 presents the academic and military means by gender at the Coast Guard Academy for technical majors. Women have a higher average CMPL (by almost 42 points).

Table 21. Academic and Military Means by Gender, Tech Majors, Coast Guard Academy

	Men	Women	Average
GRAD_CGPA	3.01	3.01	3.01
GRAD_CMPL	657.91	699.60	667.45

Hypothesis testing was conducted comparing the sample means of men and women who were technical majors for CGPA and CMPL. Testing for CMPL on these presumptions resulted in rejection of the null hypothesis at the .05 level of significance. A significant difference is found between the means of the CMPL of men and women who have a technical major at the Coast Guard Academy. The results are shown in Table 22.

Table 22. *t-test* for CMPL by Gender, Tech Majors, Coast Guard Academy

t-Test: Two-Sample Assuming Equal Variances		
	Women	Men
Mean	699.6	657.91
Variance	4848.48	7665.62
Observations	164	553
Pooled Variance	7023.39	
Hypothesized Mean Difference	0	
df	715	
t Stat	5.59	
P(T<=t) one-tail	0.000	
t Critical one-tail	1.65	
P(T<=t) two-tail	**0.000**	
t Critical two-tail	1.96	

Table 23 presents the SAT means by gender at the Coast Guard Academy for technical majors. Men have a higher SAT Math score (by almost 12 points). Women, however, have a higher SAT Verbal score (by over 17 points).

Table 23. SAT Means by Gender, Tech Majors, Coast Guard Academy

	Men	Women	Average
MATH_SAT	658.25	646.60	655.30
VERBAL_SAT	609.17	626.89	613.67

Hypothesis testing was conducted comparing the sample means of men and women who were technical majors for SAT Math and SAT Verbal. Testing for SAT Math on these presumptions resulted in acceptance of the null hypothesis at the .05 level of significance. No significant difference is found between the means of the SAT Math scores of men and women who have a technical major at the Coast Guard Academy. The results are shown in Table 24.

Table 24. *t-test* for SAT Math by Gender, Tech Majors, Coast Guard Academy

t-Test: Two-Sample Assuming Equal Variances		
	Women	Men
Mean	646.60	658.25
Variance	3593.24	3068.78
Observations	103	303
Pooled Variance	3201.197	
Hypothesized Mean Difference	0	
df	404	
t Stat	-1.81	
P(T<=t) one-tail	0.04	
t Critical one-tail	1.65	
P(T<=t) two-tail	**0.07**	
t Critical two-tail	1.97	

Testing for SAT Verbal on these presumptions resulted in rejection of the null hypothesis at the .05 level of significance. A significant difference is found between the means of the SAT Verbal scores of men and women who have a technical major at the Coast Guard Academy. The results are shown in Table 25.

Table 25. *t-test* for SAT Verbal by Gender, Tech Majors , Coast Guard Academy

t-Test: Two-Sample Assuming Equal Variances		
	Women	Men
Mean	626.89	609.17
Variance	4168.68	4532.76
Observations	103	303
Pooled Variance	4440.84	
Hypothesized Mean Difference	0	
df	404	
t Stat	2.33	
P(T<=t) one-tail	0.01	
t Critical one-tail	1.65	
P(T<=t) two-tail	**0.02**	
t Critical two-tail	1.97	

C. U.S. NAVAL ACADEMY

1. Comparison of Academic and Military Performance by Gender

This sample included all of the men and women in the graduating classes of 1997 through 2003. The sample contains 6,598 midshipmen. Of the sample, 5,640 midshipmen (85.5 percent) are male and 958 midshipmen (14.5 percent) are female.

Table 26 presents the academic and military means by gender at the Naval Academy. The data show that women have a higher average CAQPR (by .01) and a higher CMPQR (by .01) than do men.

Table 26. Academic and Military Means by Gender, Naval Academy

	Women	Men	Average
CAQPR	2.96	2.95	2.95
CMQPR	3.15	3.14	3.14

Hypothesis testing was conducted on the sample means of men and women for CAQPR and CMQPR. Testing for CAQPR on these presumptions resulted in acceptance of the null hypothesis at the .05 level of significance. No significant difference is found between the means of the CAQPR of men and women at the Naval Academy. The results are shown in Table 27.

Table 27. *t-test* for CAQPR by Gender, Naval Academy

t-Test: Two-Sample Assuming Equal Variances		
	Women	Men
Mean	2.96	2.95
Variance	0.19	0.23
Observations	958	5640
Pooled Variance	0.226	
Hypothesized Mean Difference	0	
df	6596	
t Stat	0.637	
P(T<=t) one-tail	0.262	
t Critical one-tail	1.645	
P(T<=t) two-tail	**0.524**	
t Critical two-tail	1.960	

Testing for CMQPR on these presumptions resulted in acceptance of the null hypothesis at the .05 level of significance. No significant difference is found between the means of the CMQPR of men and women at the Naval Academy. The results are shown in Table 28.

Table 28. *t-test* for CMQPR by Gender, Naval Academy

t-Test: Two-Sample Assuming Equal Variances		
	Women	Men
Mean	3.15	3.14
Variance	0.095	0.102
Observations	958	5640
Pooled Variance	0.101	
Hypothesized Mean Difference	0	
df	6596	
t Stat	1.444	
P(T<=t) one-tail	0.074	
t Critical one-tail	1.65	
P(T<=t) two-tail	**0.15**	
t Critical two-tail	1.96	

Table 29 presents the SAT means by gender at the Naval Academy. The data show that men have a higher average SAT Math score (by over 15 points). Women, on the other hand, have a higher average SAT Verbal score (by almost 8 points).

Table 29. SAT Means by Gender, Naval Academy

	Women	Men	Average
SAT Math	649.84	665.41	663.10
SAT Verbal	641.02	633.08	634.26

Testing for SAT Math on these presumptions resulted in rejection of the null hypothesis at the .05 level of significance. A significant difference is found between the means of the SAT Math scores of men and women at the Naval Academy. The results are shown in Table 30.

Table 30. *t-test* for SAT Math by Gender, Naval Academy

t-Test: Two-Sample Assuming Equal Variances		
SAT Math	Women	Men
Mean	649.84	665.41
Variance	3640.48	3897.87
Observations	570	3265
Pooled Variance	3859.66	
Hypothesized Mean Difference	0	
df	3833	
t Stat	-5.52	
P(T<=t) one-tail	0.000	
t Critical one-tail	1.645	
P(T<=t) two-tail	**0.000**	
t Critical two-tail	1.961	

Testing for SAT Verbal on these presumptions resulted in rejection of the null hypothesis at the .05 level of significance. A significant difference is found between the means of the SAT Verbal scores of men and women at the Naval Academy. These results are shown in Table 31.

Table 31. *t-test* for SAT Verbal by Gender, Naval Academy

t-Test: Two-Sample Assuming Equal Variances		
	Women	Men
Mean	641.02	633.08
Variance	4101.42	4333.30
Observations	570	3265
Pooled Variance	4298.88	
Hypothesized Mean Difference	0	
df	3833	
t Stat	2.67	
P(T<=t) one-tail	0.004	
t Critical one-tail	1.645	
P(T<=t) two-tail	**0.008**	
t Critical two-tail	1.961	

2. Comparison of Academic and Military Performance by Gender (Technical Majors)

Almost 60 percent (3,955 midshipmen) are in technical majors, and 40 percent (2,643 midshipmen) are in non-technical majors. Table 32 presents the academic and

military means by gender at the Naval Academy for technical majors. Women have a higher average CAQPR (by .01) and a higher CMPQR (by .04) than men.

Table 32. Academic and Military Means by Gender, Tech Majors, Naval Academy

	Women	Men	Average
CAQPR	3.01	3.00	3.00
CMQPR	3.21	3.17	3.18

Hypothesis testing was conducted comparing the sample means of men and women who were technical majors for CAQPR and CMQPR. Testing for CAQPR on these presumptions resulted in acceptance of the null hypothesis at the .05 level of significance. No significant difference is found between the means of the CAQPR by tech major of men and women who have a technical major at the Naval Academy. The results are shown in Table 33.

Table 33. *t-test* for CAQPR by Gender, Tech Majors, Naval Academy

t-Test: Two-Sample Assuming Equal Variances		
	Women	Men
Mean	3.01	3.00
Variance	0.209	0.239
Observations	525	3430
Pooled Variance	0.235	
Hypothesized Mean Difference	0	
df	3953	
t Stat	0.36	
P(T<=t) one-tail	0.36	
t Critical one-tail	1.65	
P(T<=t) two-tail	**0.72**	
t Critical two-tail	1.96	

Testing for CMQPR on these presumptions resulted in rejection of the null hypothesis at the .05 level of significance. A significant difference is found between the means of the CMQPR of men and women who have a technical major at the Naval Academy. These results are shown in Table 34.

Table 34. *t-test* for CMQPR by Gender, Tech Majors, Naval Academy

t-Test: Two-Sample Assuming Equal Variances		
CMQPR - Tech Major		
	Women	Men
Mean	3.21	3.17
Variance	0.09	0.10
Observations	525	3430
Pooled Variance	0.10	
Hypothesized Mean Difference	0	
df	3953	
t Stat	2.45	
P(T<=t) one-tail	0.007	
t Critical one-tail	1.65	
P(T<=t) two-tail	**0.014**	
t Critical two-tail	1.96	

Table 35 presents the SAT means by gender at the Naval Academy for technical majors. Men have a higher SAT Math score (by almost 15 points). Women, on the other hand, have a higher SAT Verbal score (by over 6 points).

Table 35. SAT Means by Gender, Tech Majors, Naval Academy

	Women	Men	Average
SAT Math	664.38	679.13	677.10
SAT Verbal	639.85	633.76	634.60

Hypothesis testing was conducted comparing the sample means of men and women who were technical majors for SAT Math and SAT Verbal. Testing for SAT Math on these presumptions resulted in rejection of the null hypothesis at the .05 level of significance. A significant difference is found between the means of the SAT Math scores of men and women who have a technical major at the Naval Academy. The results are shown in Table 36.

Table 36. *t-test* for SAT Math by Gender, Tech Majors, Naval Academy

t-Test: Two-Sample Assuming Equal Variances		
	Women	Men
Mean	664.38	679.13
Variance	3620.95	3769.6
Observations	308	1933
Pooled Variance	3749.22	
Hypothesized Mean Difference	0	
df	2239	
t Stat	-3.92	
P(T<=t) one-tail	0.000	
t Critical one-tail	1.646	
P(T<=t) two-tail	**0.000**	
t Critical two-tail	1.96	

Testing for SAT Verbal on these presumptions resulted in acceptance of the null hypothesis at the .05 level of significance. No significant difference is found between the means of the SAT Verbal scores of men and women who have a technical major at the Naval Academy. The results are shown in Table 37.

Table 37. *t-test* for SAT Verbal by Gender, Tech Majors, Naval Academy

t-Test: Two-Sample Assuming Equal Variances		
	Women	Men
Mean	639.85	633.76
Variance	4177.91	4305.57
Observations	308	1933
Pooled Variance	4288.07	
Hypothesized Mean Difference	0	
df	2239	
t Stat	1.517	
P(T<=t) one-tail	0.065	
t Critical one-tail	1.646	
P(T<=t) two-tail	**0.13**	
t Critical two-tail	1.96	

D. CROSS TABULATIONS

The purpose of this analysis is to measure the relationship between women at both service academies with respect to Grad GPA, SAT Math, and SAT Verbal. The results of the cross tabulations are presented because they show there is a correlation between the

graduating GPAs, SAT Math, and SAT Verbal for women at the service academies, and the results of their significance show that the women selected to the academies have grades and SAT scores similar to one another.

1. Coast Guard Academy and Naval Academy (Grad GPA)

Using Pearson's R, the relationship between graduating GPAs for women at both institutions is statistically significant ($p<0.05$). The results of the cross tabulations for women at the service academies are presented in Table 38.

Table 38. Correlation Table for Grad GPA

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
	Pearson's R	.096	.028	3.436	**.001(c)**
N of Valid Cases		1,278			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.
c. Based on normal approximation.
d. Gender = women.

2. Coast Guard Academy and Naval Academy (SAT Math)

Using Pearson's R, the relationship between SAT Math for women at both institutions is statistically significant ($p<0.05$). The results of the cross tabulations for women at the service academies are presented in Table 39.

Table 39. Correlation Table for SAT Math

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
	Pearson's R	.125	.035	3.474	**.001(c)**
N of Valid Cases		763			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.
c. Based on normal approximation.
d. Gender = women.

3. Coast Guard Academy and Naval Academy (SAT Verbal)

Using Pearson's R, the relationship between SAT Verbal for women at both institutions is statistically significant ($p<0.05$). The results of the cross tabulations for women at the service academies are presented in Table 40.

Table 40. Correlation Table for SAT Verbal

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
	Pearson's R	.089	.036	2.462	**.014(c)**
N of Valid Cases		763			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.
c. Based on normal approximation.
d. Gender = women.

E. CHAPTER SUMMARY

Table 41 presents a summary of the results, showing significant differences (yes or no) by variable tested and whether the statistical difference favors men or women.

Table 41. Summary Table

Group	Test	Sig Difference	Dif Favors
	CGPA	no	n/a
Coast Guard	CMPL	yes	women
Academy	SAT Math	yes	men
	SAT Verbal	yes	women
	CGPA	no	n/a
Coast Guard Academy	CMPL	yes	women
(Tech Major)	SAT Math	no	n/a
	SAT Verbal	yes	women
	CAQPR	no	n/a
Naval Academy	CMQPR	no	n/a
	SAT Math	yes	men
	SAT Verbal	yes	women
	CAQPR	no	n/a
Naval Academy	CMQPR	yes	women
(Tech Major)	SAT Math	yes	men
	SAT Verbal	no	n/a

In this chapter, the data set and variables were analyzed to examine the academic and military performance of men and women at both institutions. Women at the two service academies faired extremely well when compared with men on the basis of selected variables. The academic performance for women when compared with their counterparts at the Coast Guard Academy showed no significant difference. However, militarily, women performed on average better than men, and this result was statistically significant for all cadets as well as for those who are technical majors. The academic performance of women was better when compared with that of their male counterparts at the Naval Academy; however, these differences were not statistically significant. . Militarily, women performed generally better than did men, but this result was only statistically significant for midshipmen who are technical majors. At the Coast Guard and Naval Academy, SAT Math scores, on average, were higher for men when compared

with those of their female counterparts. These differences were all statistically significant and favoring men. On the other hand, the SAT Verbal tended to be higher for women when compared with that for men. These differences favoring women were statistically significant with the notable exception of the SAT Verbal for Tech Majors. The results of the analysis in this chapter are used to formulate conclusions and recommendations in Chapter V.

V. CONCLUSIONS

A. OVERVIEW

This study compares the academic and military performance of women with that of men at the U.S. Naval Academy and U.S. Coast Guard Academy. A number of hypotheses were tested using quantitative analyses. Briefly, results show that, based on selected measures, women at the two service academies perform as well or better than do their male counterparts. This was especially true for measures of military proficiency, where women outperformed men generally (all academic majors) and among those who were enrolled in a technical major. The conclusions of the study are presented below, using the format of question and answer. Included here are further thoughts on the similarities and differences found in comparing results from the two academies.

B. CONCLUSIONS

1. Does the *Academic Performance* of Women Differ from that of Men at the U.S. Naval Academy?

Women at the U.S. Naval Academy generally outperform men with regard to academic achievement. However, the difference was *not* found to be statistically significant.

2. Does the *Military Performance* of Women Differ from that of Men at the U.S. Naval Academy?

Women at the U.S. Naval Academy generally outperform men with regard to military achievement. However, the difference was *not* found to be statistically significant.

3. Does the A*cademic Performance of Women with a Technical Major* Differ from that of their Male Counterparts at the U.S. Naval Academy?

Women at the U.S. Naval Academy with a technical major generally outperform men with regard to academic achievement. However, the difference was *not* found to be statistically significant.

4. Does the *Military Performance of Women with a Technical Major* Differ from that of their Male Counterparts at the U.S. Naval Academy?

Women at the U.S. Naval Academy with a technical major generally outperform men with regard to military achievement. The difference *was* found to be statistically significant.

5. Does the *Academic Performance* of Women Differ from that of Men at the U.S. Coast Guard Academy?

Women at the U.S. Coast Guard Academy generally do not perform as well as men with regard to academic achievement. However, the difference was *not* found to be statistically significant.

6. Does the *Military Performance* of Women Differ from that of Men at the U.S. Coast Guard Academy?

Women at the U.S. Coast Guard Academy generally outperform men with regard to academic achievement. The difference *was* found to be statistically significant.

7. Does the *Academic Performance of Women with a Technical Major* Differ from that of their Male Counterparts at the U.S. Coast Guard Academy?

Women at the U.S. Coast Guard Academy with a technical major on average perform the *same* as men with regard to academic achievement.

8. Does the *Military Performance of Women with a Technical Major* Differ from that of their Male Counterparts at the U.S. Coast Guard Academy?

Women at the U.S. Coast Guard Academy with a technical major generally outperform men with regard to military achievement. The difference *was* found to be statistically significant.

9. Are there any Particular Trends in Academic or Military Performance Outcomes by Gender that are Common to the U.S. Naval Academy and U.S. Coast Guard Academy?

Women and men at both academies tend to perform similarly with respect to academic measures, as reported above. When differences were found, they favored women; but these differences were not statistically significant.

This finding is not unexpected. Young men and women who are admitted to the academies are often similar with respect to academic achievement. A background in mathematics, for example, is highly encouraged and sought in applicants by each institution. In fact, both institutions tend to look for similar types of students in their admissions process, and many students actually apply to both academies. Thus, the

combination of self-selection and institutional standards at these academies result in the enrollment of students with many comparable background characteristics, activities, scholastic preparation, and chances for success.

Women at both institutions tend to outperform their male counterparts in military proficiency grades. This finding is consistent with that of Bartone, Snook, and Tremble (2002), who compared male and female cadets at the U.S. Military Academy. Indeed, women likely tend to work much harder to achieve success on military factors in the traditionally male environment at the service academies. Admissions staffs seek applicants who demonstrate leadership traits, and this dimension could be relatively more selective for women than for men. Further, young women who apply must certainly know that they would be a minority at the service academies (representing between 27 percent at the Coast Guard Academy and 15 percent at the Naval Academy in the years studied), and that they might need to overcome some lingering prejudices of them as a "weaker sex." Consequently, one can surmise that young women who are accepted by the academies have a strong constitution at the start, applying and earning admission in the tight competition, and that they continue to be highly motivated.

It is interesting to observe, when students with technical majors are isolated, wider differences are found between the military proficiency grades for men and women, with women outperforming men at both academies. Again, this might indicate that the women are working doubly hard to succeed in two traditionally-male domains, that of the technical academic major and in military performance factors; and those who choose a technical major could be even more highly motivated to excel in military areas. As Lynn and Mau (2001) and Hyde and Kling (2001) also concluded, such differences could be attributed to a stronger work ethic on the part of women, who are using the "level playing field" to their greatest advantage.

10. Are there any Differences between the Aptitude Test Scores and Academic Achievements of Women and Men at the U.S. Naval Academy and U.S. Coast Guard Academy with regard to SAT Scores?

Generally, male students at the Naval Academy and Coast Guard Academy enter with a higher SAT Math score, and female students enter with a higher SAT Verbal

score. This coincides with previous research on gender differences in SAT scores of students admitted to the service academies (see Young and Fisler, 2000; and Lynn and Mau, 2001).

Women at the Naval Academy outperform their male counterparts in AQPR and on the SAT Verbal, regardless of major (technical or otherwise). At the Coast Guard Academy, women also tend to score higher than men on the SAT Verbal; gender differences in scores on the CGPA, though favoring men, are not statistically significant.

Previous studies have found that women tend to excel academically over their male counterparts, even when controlling for college aptitude test scores, such as the SAT and ACT (Lynn and Mau, 2001; Leonard and Jiang, 1999). This contrasts with the results of the present study at the Coast Guard Academy, despite the findings that women had higher SAT Verbal scores and statistically similar SAT Math scores as did their male counterparts.

The results are perhaps more understandable when looking at students who are enrolled in a technical major. Here women at the Coast Guard Academy tend to outperform men on the SAT Verbal, but show no significant difference in scores on the SAT Math. Since SAT Math is likely to be more predictive than SAT Verbal of performance in a technical major, it is surprising to find that male-female differences on the CGPA are not statistically significant. At the same time, although men at the Naval Academy outperform women on the SAT Math and exhibit no difference on the SAT Verbal, following the same hypothesis, one would expect men at the Naval Academy to outperform women academically in technical majors. Yet, this is not the case; no statistically significant difference is found in the academic performance of men and women who are enrolled in a technical major at the Naval Academy. Once again, the results suggest that women at both institutions are highly motivated to succeed, militarily as well as academically; and the more non-traditional the setting, such as technical majors and military proficiency, the more women tend to defy traditional differences.

C. RECOMMENDATIONS

Men and women at the service academies should know that, on average, women are performing at least as well as their male counterparts academically and militarily,

based on the measures used in the present study. The best way to get this point across is to place successful cadets, regardless of gender, in company and regimental positions. The message of gender equity should be loud and clear, and most importantly to men at the academies.

The present study was limited in scope. Further research on issues regarding gender equity and observed differences in performance could explore several areas. These include the following:

a. It has been suggested that, on average, women at the academies are more highly motivated than their male counterparts to succeed. Thus, for example, the motivation or drive among female students helps to explain why they tend to outperform men on military proficiency grades; and it helps to explain, again, why women in technical majors, although possessing lower SAT Math scores upon entry to the Naval Academy, apparently do about as well academically as do their male counterparts. A study could be designed to examine this notion of greater drive to succeed by surveying several cohorts of male and female students longitudinally.

b. A study similar to that reported here could be conducted periodically, say, every two or three years to monitor gender differences and to compare results at the two maritime academies. This would facilitate identifying areas that are possibly in need of process improvement.

c. In 2002, Bartone, Snook, and Tremble examined cognitive personality predictors of leadership performance at the U.S. Military Academy. A study such as this for the Coast Guard Academy could help the admissions staff select even better cadets, both female and male, especially with respect to military performance. The results might also assist the admissions staff in better understanding gender differences in military performance at the Coast Guard Academy.

d. Male and female graduates of the academies could be tracked throughout their careers, comparing performance at the academies with performance in the fleet. For example, do those who demonstrate outstanding leadership skills at

the academies continue to show such abilities in the operational environment over the short term or many years later? How do academy and military-related achievements compare, individually and combined, with later performance in one's career. Further, do trends or career patterns hold equally for both genders and for graduates of both academies?

D. FINAL NOTE

Many personal and organizational adjustments were obviously necessary when women were first admitted to the service academies in 1976. That was nearly 30 years ago, yet it is clear that gender integration is an ongoing process, and one that will likely continue for years to come.

For whatever reason, self-selection, admissions criteria, motivation, or a combination of many factors, women have been performing exceptionally well at both the U.S. Naval Academy and U.S. Coast Guard Academy when measured by the indicators studied here. This is a trend that should last; and, with the help of academy officials, admissions staffs, and students themselves, one day the process of gender integration will be completed.

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